

3. Reducing Emissions from Energy End Use and Transportation

Reducing Energy Demand at Stationary Sources

Energy use at stationary sources in the residential, commercial, and industrial sectors accounted for 3.7 billion metric tons of carbon dioxide emissions in 1999—about two-thirds of U.S. carbon dioxide emissions. Emissions from stationary-source energy use included nearly 2 billion metric tons of carbon dioxide from the generation of electricity that was ultimately consumed in these three sectors. Industry was the largest of the three sectors in terms of stationary-source emissions, accounting for nearly half the total; the residential sector accounted for about 29 percent of the total energy-related emissions from stationary sources, and the commercial sector contributed an additional 24 percent.²¹

Between 1990 and 1999, carbon dioxide emissions associated with industrial, residential, and commercial energy use increased by 10.7 percent. The commercial sector is the fastest-growing emissions source, having registered a 17.2 percent increase in emissions between 1990 and 1999. Emissions from the residential sector increased by 14.1 percent over the same period, and industrial sector emissions rose by 5.8 percent.²²

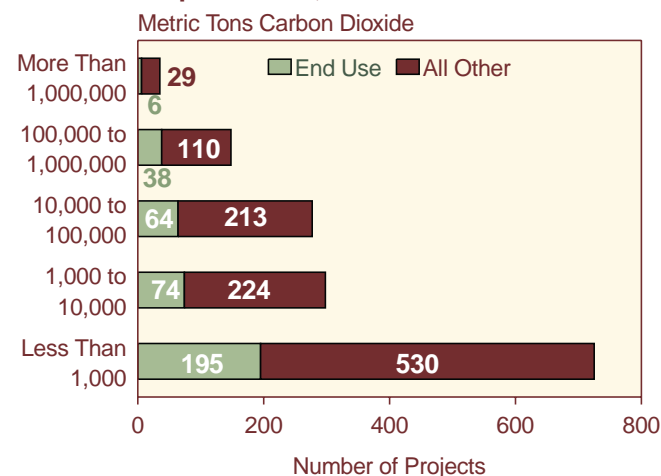
Projects Reported

Energy end-use projects accounted for 22 percent of all projects reported to the Voluntary Reporting of Greenhouse Gases Program for 1999, third behind electricity supply and carbon sequestration in the number of projects reported. These projects involve reductions in end-use demand for energy or fuel switching.

Ninety-eight entities reported energy end-use projects in 1999. Most (69) were electric power providers. The other reporters were industrial companies dominated by a group of six cement plants (divisions of Essroc Cement Corp.), chemical products companies (Allergan, Inc., Clairol, Johnson & Johnson, and Pharmacia & Upjohn), and transportation equipment companies (General Motors, Pratt & Whitney North Berwick, and Rolls-Royce Corporation).

Emission reductions reported for individual energy end-use projects ranged from less than 1 metric ton to almost 3 million metric tons, primarily because of the flexibility allowed in defining the scope of a project. Projects could range from the installation of a compact fluorescent light bulb reported by a household to a system-wide demand-side management (DSM) program reported by a large utility. Like other project types, most energy end-use projects (88 percent) fell in the emission reduction range of less than 100,000 metric tons carbon dioxide equivalent (Figure 8). Thirty-eight end-use projects reported emission reductions between 0.1 and 1 million metric tons, and six end-use projects reported reductions in excess of 1 million metric tons each. In total, reductions reported for 1999 for energy end-use projects were nearly 23.2 million metric tons carbon dioxide equivalent.

Figure 8. Reported Energy End-Use Projects Compared to All Other Projects by Size of Carbon Dioxide Reduction or Sequestration, Data Year 1999



Note: The project sizes shown are only for reported carbon dioxide reductions. "All Other" does not include end-use projects or projects for which no carbon dioxide reduction or sequestration was reported.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

²¹In terms of their contribution to total energy-related carbon dioxide emissions in 1999, the industrial sector led with a 32-percent share of the total, followed by the residential sector (19 percent) and the commercial sector (16 percent). Transportation, which is considered in the next section of this chapter, accounted for the remaining 32 percent.

²²Energy Information Administration, *Emissions of Greenhouse Gases in the United States 1999*, DOE/EIA-0573(99) (Washington, DC, October 2000), pp. 15-27, <http://www.eia.doe.gov/oiaf/1605/1605a.html>.

Project Types

A total of 98 entities reported on 379 energy end-use projects for 1999. Most of the reported projects, particularly the DSM programs reported by electric utilities, targeted multiple end uses. Overall, the most frequently reported type of energy end-use project was lighting and lighting controls, followed by equipment and appliances and by heating, ventilation, and air conditioning (HVAC) (Figure 9).

The average emission reductions for energy end-use projects vary by project type (Table 7). For projects involving industrial power systems, the average was 57,579 metric tons carbon dioxide equivalent per project, compared with 397,619 metric tons per project for projects involving the energy effects of urban forestry. General energy use (found on Form EIA-1605EZ only) and industrial power systems projects reported for 1999 form the smallest emission reduction groups, whereas HVAC and load control projects form the largest.

Energy end-use projects can be carried out anywhere energy is consumed. For this report, energy end-use projects are categorized as occurring in the industrial, commercial, residential, and agricultural sectors. End-use projects reported for 1999 in the industrial sector (179) outnumbered those in the residential (125) and commercial (124) sectors, which, in turn, greatly outnumbered agricultural sector projects (22) (Figure 10).

Fewer projects were reported in 1999 for the residential and agricultural sectors than were reported for the 1998 data year, down by 5 projects and 1 project, respectively. In contrast, 5 more end-use projects were reported for the commercial sector and 9 more were reported for the

New Projects

Thirty-four new energy end-use projects were reported as having begun in 1999, as compared with only 21 in 1998—a 62-percent increase. Two reporters accounted for 15 of the 34 new projects reported. Clairol, a new reporter and a part of the health and personal care company Bristol-Myers Squibb, led the reporting with 8 new projects involving lighting, HVAC, and motor drive efficiency. Clairol estimated the total carbon dioxide emission reductions resulting from its new projects at slightly over 300 metric tons in 1999.

The other primary reporter of new projects was Allergan, Inc., another health care company that began reporting to the Voluntary Reporting of Greenhouse Gases Program in the 1998 data cycle. Allergan, Inc. reported seven projects initiated in 1999 involving HVAC, lighting, and equipment efficiency and load control and estimated total emission reductions from the projects at roughly 836 metric tons carbon dioxide equivalent in 1999.

Table 7. Number of Projects and Emission Reductions Reported for Energy End-Use Projects by Project Type, Data Year 1999

Project Type	Number of Projects Reported	Emission Reductions (Metric Tons Carbon Dioxide Equivalent)	
		Total Emission Reductions	Average Emission Reductions per Project
Lighting/Lighting Controls	155	18,256,505	117,784
Equipment/Appliances	147	16,419,771	111,699
HVAC	105	18,468,733	175,893
Motor/Motor Drive	64	13,902,212	217,222
Load Control	64	12,039,352	188,115
Building Shell	63	14,667,560	232,818
General Energy Use*	15	187,078	12,472
Fuel Switching	21	5,178,641	246,602
Energy Effects of Urban Forestry . . .	8	3,180,950	397,619
Industrial Power Systems	2	115,158	57,579
Other**	25	1,489,951	59,598
Total	379	23,168,811	61,131

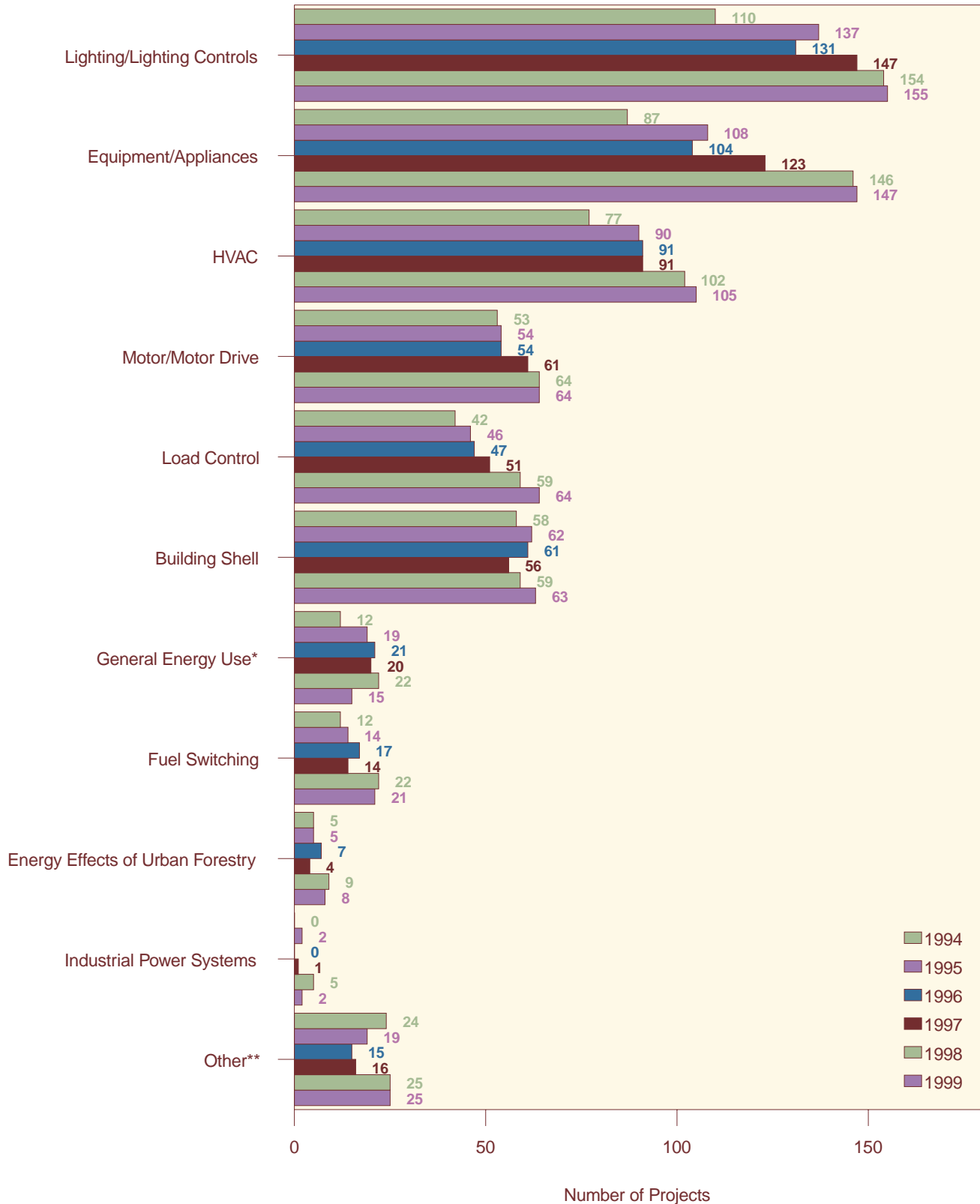
*Includes projects reported on Form EIA-1605EZ that encompass more than one project type. Because Form EIA-1605 allows reporters to identify multiple project types encompassed by a project, the General End Use category is specific to Form EIA-1605EZ reporting.

**Includes all projects that cannot meaningfully be included in any of the specific project type categories.

Notes: Project totals and emission reductions do not equal sum of components, because some projects are counted in more than one category.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Figure 9. Reported Energy End-Use Projects by Project Type, Data Years 1994-1999



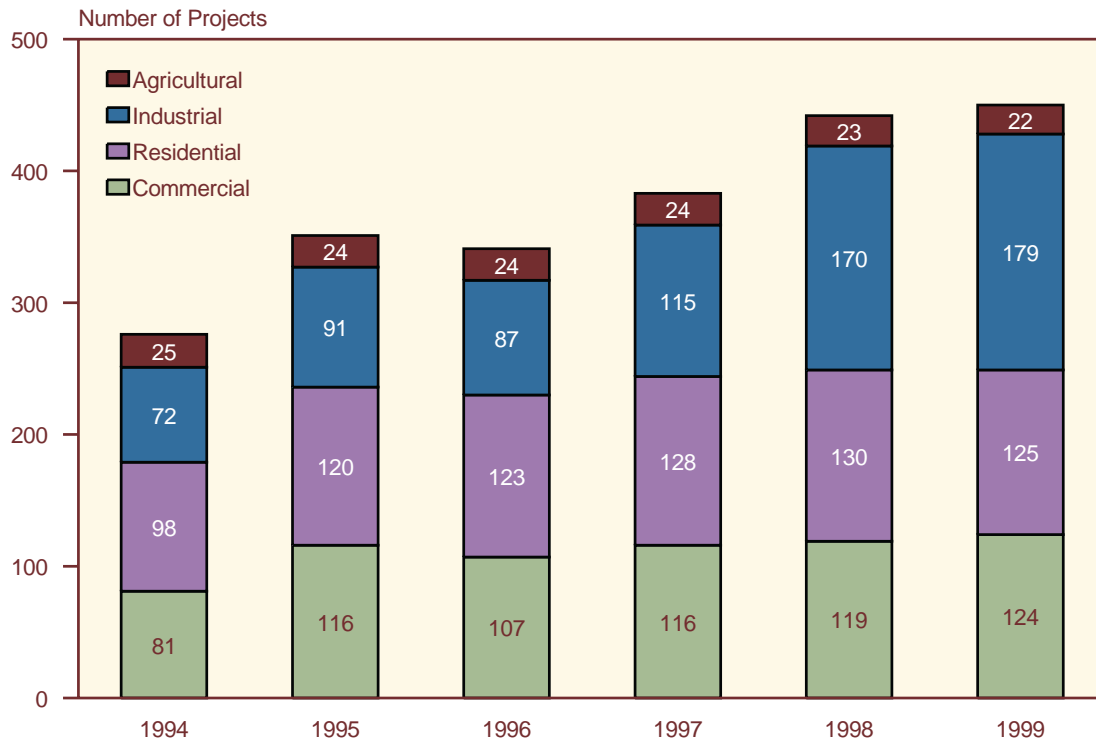
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Note: Some projects are counted in more than one category.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Figure 10. Reported Energy End-Use Projects by Sector, Data Years 1994-1999



Notes: Excludes energy end-use projects reported on Form EIA-1605EZ. Some projects target more than one sector and may be counted in multiple categories.

Source: Energy Information Administration, Form EIA-1605.

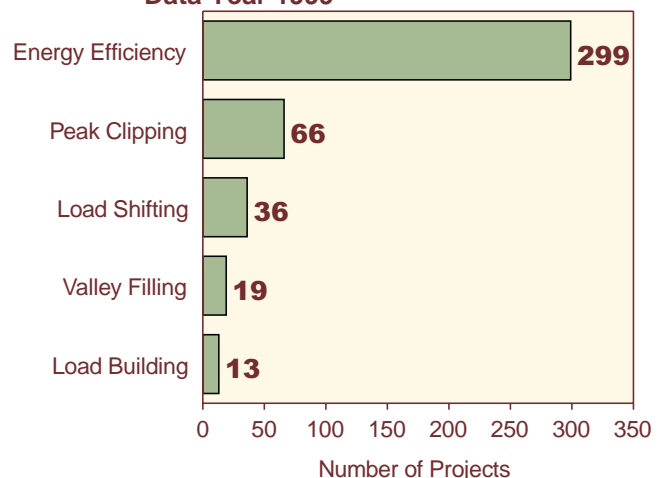
industrial sector, which showed the largest increase. It should be noted that many projects—particularly utility DSM programs—cover more than one end-use sector and are included in each applicable sector for the purposes of counting types of projects reported.

The average carbon dioxide equivalent emission reduction reported per project also varies by sector. Individual projects in the residential sector (146,771 metric tons carbon dioxide equivalent average per project) yielded slightly larger average carbon dioxide emission reductions than those in the commercial sector (141,517 metric tons average per project) or the industrial sector (99,219 metric tons average per project). The reductions reported for projects involving the agricultural sector (437,837 metric tons average per project) averaged almost three times those reported for projects in the residential sector. Two large-scale DSM projects involving the agricultural sector claimed the largest emission reductions reported for any project in 1999. The two projects, reported by Southern California Edison Co. and Wisconsin Electric Power Co., aggregated activities covering all four sectors. Only 2 of the 22 projects reported for the agricultural sector did not also involve other sectors.

Although the most common load shape objective of reported DSM projects was increased energy efficiency (299 projects), utilities also attempted to balance their

load profiles with various other load shape objectives. Peak clipping (66 projects) was the second most common load shape objective reported, followed by load shifting (36 projects), valley filling (19 projects), and load building (13 projects) (Figure 11).

Figure 11. Reported Demand-Side Management Projects by Load Shape Objective, Data Year 1999



Notes: Excludes demand-side management projects reported on Form EIA-1605EZ. Some projects may be counted in more than one category.

Source: Energy Information Administration, Form EIA-1605.

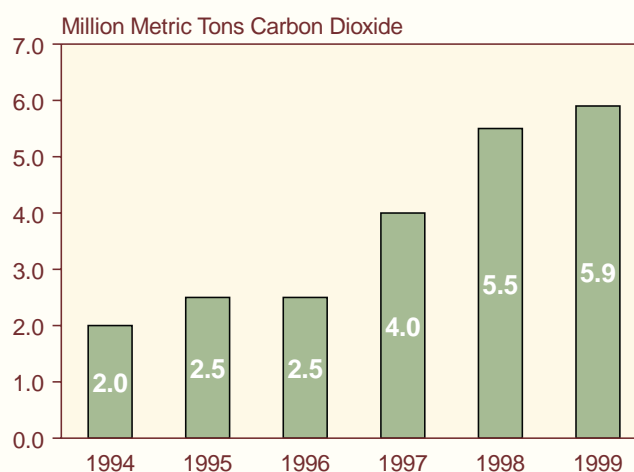
Coal Ash Reuse Projects

Coal ash, a byproduct of coal combustion, continues to be a marketable commodity for the electric utility industry. The most conventional use of coal ash is as a replacement for Portland cement in the manufacture of concrete. Reductions in carbon dioxide emissions are achieved not through reductions in energy usage but through reductions in emissions from the calcination process. Electric utilities sell coal ash produced at their facilities to avoid landfill disposal costs and to meet increasing demand for the commodity.

In 1999, the total number of entities reporting coal ash reuse projects (38) dropped slightly from the 42 entities reporting such projects in 1998. There was a matching decrease in the total number of projects reported for 1999 (41), down from 45 reported for 1998. Despite the smaller number of projects reported for 1999, the total carbon dioxide emission reductions reported increased by 7 percent from the 1998 total, to 5.9 million metric tons (see figure). The combined reductions reported for coal ash reuse projects in 1999 accounted for more than 3 percent of the carbon dioxide emission reductions reported for all projects. Almost 8 million metric tons of coal ash was reported to have been reused in 1999, primarily as a substitute for Portland cement in concrete manufacturing. A small assortment of reporters indicated that fly ash was reused in materials including road base, anti-skid material, or structural fill; however, emission reductions from these applications were not quantified. The largest quantities of coal ash reused were reported by PacifiCorp (over 700,000 metric tons) and by TXU (over 600,000 metric tons).

Reporters used different emission coefficients to estimate their carbon dioxide reductions for cement substitution, ranging from 0.8 to 1.0 metric ton per ton of coal ash reused. The coefficients varied depending on the fuel used to fire the kilns, the proportion of coal ash used in cement, and the electricity used to grind raw materials. Other coefficients were derived from the ratio of the molecular weights of carbon dioxide and calcium oxide (the chemical compounds involved in the calcination of limestone) and the ratio of the specific gravities of coal ash and cement.

Reported Reductions from Coal Ash Reuse Projects, Data Years 1994-1999



Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Load Shape Effects: Definitions and Terminology

Energy Efficiency. Projects that improve the energy efficiency of specific end-use devices and systems. Such projects usually reduce overall energy consumption, often without regard for the timing of project-induced savings. Generally, energy savings are achieved through the substitution of technically more efficient measures (i.e., equipment, systems, or operating procedures) to produce the same level of end-use service (e.g., lighting or warmth) with less energy use.

Load Building. Projects that increase energy consumption, generally without regard to the timing of the increase. Promotion of residential electric space heating systems and promotion of new industrial electrotechnologies are examples of electricity load-building projects.

Load Shifting. Projects that move energy consumption from one time to another (usually during a single day). For example, water-heater timers typically turn off the

units during the daytime (when an electric utility experiences peak demands) and allow the units to operate at night (during the utility's off-peak period).

Peak Clipping. Projects that reduce energy demand at certain critical times, typically when the utility experiences system peaks. These projects generally have only small effects on overall energy use but focus sharply on reducing energy use at critical times. Load-shifting and peak-clipping differ because the former shifts much of the energy use from one time to another, whereas the latter eliminates a load without shifting it to another time period.

Valley Filling. Projects that increase off-peak energy consumption (without necessarily reducing on-peak demands). Replacement of a natural-gas-fired furnace with an electric heat pump (with backup heat provided by natural gas) is an example of valley filling. Such projects can aim to fill daily or seasonal valleys.

Reducing Transportation Fuel Use

Overview

A total of 73 transportation projects were reported for 1999 by 43 entities, all but 6 of which were electric utilities or, in the case of CLE Resources, a subsidiary of an electric utility. The 6 others were a telecommunication company (AT&T), an automobile manufacturer (Volvo Cars of North America, Inc.), a printing company (Quad/Graphics, Inc.), a food industry company (Essential Foods, Inc.), a cement producer (Arizona Portland Cement Co.), and a household. Detailed information was provided for 62 (85 percent) of the projects on Form EIA-1605. Summary information for the remaining 11 projects was reported on Form EIA-1605EZ. Forty-five (62 percent) of the projects reported for 1999 were affiliated with either the Climate Challenge or Climate Wise program.

Table 8 shows transportation project trends in the first six reporting cycles of the Voluntary Reporting Program. The projects reported for 1999 fall into three broad categories:²³

- Alternative fuel use (34 projects or 47 percent)
- Travel reduction (32 projects or 44 percent)
- Vehicle efficiency improvements (9 projects or 12 percent).

The primary effect of the transportation projects reported was to reduce emissions of carbon dioxide, although reductions in emissions of nitrous oxide or methane were also reported for 5 projects. For 11 of the 73 projects reported, either reductions did not occur in 1999 or they were not estimated.²⁴ Total emission reductions in 1999 reported for the remaining 61 transportation projects were 327,627 metric tons carbon dioxide equivalent, an increase of 151 percent over the total reported for 1998 and more than 15 times the 21,280 metric tons reported in the first (1994) reporting cycle.

Five projects accounted for 85 percent of the increase in reductions reported for transportation projects in 1999 compared to those for 1998. CLE Resources reported a reduction of 101,440 metric tons of carbon dioxide for its share of a vehicle efficiency project, up from 12,216 metric tons for 1998. AT&T, a new reporter, claimed a reduction of 36,287 metric tons of carbon dioxide for a telecommuting project. Quad/Graphics, which did not submit a report for 1998, reported three demand reduction projects that together reduced carbon dioxide emissions by an estimated 41,238 metric tons in 1999.

Nearly half (47 percent) of the projects reported for 1999 involved alternative fuel vehicles (AFVs). However, the reported reductions achieved by individual AFV projects were small, accounting for only about 8 percent of the reductions reported for transportation projects in 1999 (Table 8). Vehicle efficiency projects tend to have larger effects than other transportation projects. The

Table 8. Number of Projects and Emission Reductions Reported for Transportation Projects by Project Type, Data Years 1994-1999

Year	Number of Projects				Emission Reductions (Metric Tons Carbon Dioxide Equivalent)			
	Vehicle Efficiency	Travel Reduction	Alternative Fuels	Total	Vehicle Efficiency	Travel Reduction	Alternative Fuels	Total
1994	3 ^(R)	9	22	33	6,895 ^(R)	1,504 ^(R)	13,047	21,280
1995	6	19	26 ^(R)	50	54,285	20,248	12,558 ^(R)	86,930
1996	7	18	34 ^(R)	58 ^(R)	57,250	20,531	17,372 ^(R)	95,036
1997	9 ^(R)	22	34 ^(R)	64 ^(R)	69,202 ^(R)	54,202	18,831 ^(R)	142,183 ^(R)
1998	10	30	35	72	88,964	20,492	21,299	130,755
1999	9	32	34	73	187,967	114,740	25,063	327,627

(R) = revised.

Note: Project and emission reduction totals may not equal sum of components because projects may be counted in more than one category. Emission reductions are those reported for the latest data year in each reporting cycle (e.g., 1998 reductions are those reported for 1998 on Forms EIA-1605 and EIA-1605EZ submitted in 1999). Reductions were not reported for the latest year for all projects.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

²³The sum of projects in each category exceeds the total number of projects because some projects are counted in more than one category.

²⁴In some cases, reductions for the project may have been reported for years prior to 1999. In other cases, the reductions were not estimated due to the lack of data or other difficulties in quantifying the effects of the project. Entities may elect to report projects without reporting reductions to make a public record of the fact that they have conducted an activity in fulfillment of a commitment made under a voluntary program such as Climate Challenge.

nine projects reported in this category accounted for over half (57 percent) of the estimated 1999 emission reductions for transportation. Travel reduction, which includes such activities as car pooling and van pooling, mass transit, telecommuting, and service efficiency improvements, accounted for 32 projects and about 35 percent of the reductions reported for 1999. The average emission reduction reported per project by transportation project type for 1999 is summarized in Figure 12.

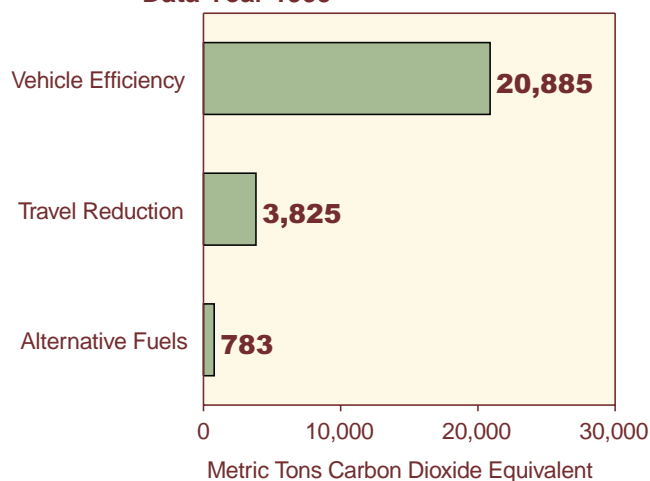
Even relatively large travel reduction projects tend to have a limited effect on emissions. For example, to achieve a reduction in carbon dioxide emissions of 104 metric tons in 1999, the City of Palo Alto, CA, eliminated an estimated 328,320 vehicle miles traveled by increasing mass transit ridership. Although individual transportation initiatives may produce only modest emission reductions, many of the projects reported to the program have wide applicability and could significantly reduce national carbon dioxide emissions if they were duplicated by other companies or employed on a wide scale.

Using Alternative Fuels

Alternative fuel vehicle projects involved a variety of fuels, including natural gas, electricity, propane, and M-85 (a blend of 85 percent methanol and 15 percent gasoline). More than 90 percent of the reductions reported for 1999 associated with alternative fuels were attributed to vehicles using natural gas, which was the subject of 17 project reports. Five utilities reported operating fleets of compressed natural gas (CNG) or dual-fuel CNG/gasoline vehicles of more than 100 vehicles in 1999: Wisconsin Electric Power Company (688 vehicles), PG&E Corporation (633 vehicles), NiSource (618 vehicles), TXU (266 vehicles), and Baltimore Gas and Electric (161 vehicles).

Another 17 projects involved the operation of electric vehicles. Although the emission reductions reported for electric vehicle projects in 1999 were relatively small—about 9 percent of the total reductions (carbon dioxide equivalent) reported for alternative fuel vehicles—they have increased from just 2 percent of alternative fuel vehicle reductions for 1997. Some utilities are now operating sizable fleets of electric vehicles. Southern California Edison's electric vehicles reportedly logged over 2 million miles in 1999, more than 10 times the 174,000 miles reported in 1996. The Los Angeles Department of Water and Power (LADWP) reported operating 75 electric vehicles in 1999, up from 18 in 1996. Southern Company reported that more than 100 of its employees drove electric vehicles as their primary transportation in 1999.

Figure 12. Average Emission Reductions for Transportation Projects by Type, Data Year 1999



Note: Mean emission reductions reflect only those projects for which estimates were reported.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Two projects involved fuels other than natural gas and electricity. UNICOM and the Tennessee Valley Authority reported using M-85, and UNICOM also reported the conversion of 82 Dodge Neons to propane.

Reducing Vehicle Travel

Travel reduction accounted for 35 percent of the total reduction in carbon dioxide equivalent emissions reported for transportation projects for 1999, up from the 3 percent reported for 1994. Of the 32 projects reported in this category, 13 involved car pooling or van pooling, 10 increased mass transit ridership, 5 reduced employee vehicle use through telecommuting, 4 increased service efficiency for freight or service vehicles, and 8 involved other actions, such as work week compression, videoconferencing, and use of bicycles for commuting and utility meter reading.²⁵

The largest travel reduction project was a telecommuting project reported for the first time by AT&T. This project reduced emissions by a reported 36,287 metric tons carbon dioxide equivalent in 1999 by lowering employee vehicle miles traveled by over 87 million miles. Substantial emission reductions were also reported by Quad/Graphics for a project that uses its delivery vehicles to pick up raw materials and supplies on return trips. Quad/Graphics estimates that the project reduced carbon dioxide emissions by nearly 30,522 metric tons in 1999. Reductions of more than 5,000 metric tons carbon dioxide equivalent were also reported for the following travel reduction projects:

²⁵The total number of travel reduction projects is less than the sum of the projects in each subcategory because some individual projects include activities in more than one subcategory.

- Quad/Graphics reported moving to 12-hour work shifts at its printing plants (10,305 metric tons).
- LADWP reported on its employee car pooling and van pooling program (8,475 metric tons).
- TXU reported efforts to reduce fleet vehicle use (7,426 metric tons).
- Public Service Enterprise Group reported on its employee car pooling, van pooling, and mass transit programs (6,969 metric tons).
- CLE Resources reported its investment, through the Edison Electric Institute's EnviroTech investment fund, in McHugh Software, a company that developed software to improve routing for service vehicles (5,589 metric tons).

Improving Vehicle Efficiency

Nine projects involving vehicle efficiency improvements were reported, five of which claimed relatively large carbon dioxide emission reductions (more than 10,000 metric tons) in 1999. Four Midwestern utilities reported the use of aluminum railroad cars to transport coal to their plants. Ameren Corporation, which was

formed by the merger of Union Electric Company and Central Illinois Public Service Company, reported reducing 1999 carbon dioxide emissions by 33,941 metric tons. Substantial reductions in carbon dioxide emissions were reported by three other utilities using aluminum coal cars: Kansas City Power & Light (21,234 metric tons), Western Resources, Inc. (16,665 metric tons), and UNICOM (14,302 metric tons).

CLE Resources, a subsidiary of Central Louisiana Electric Company, reported its investment in a company that developed and commercialized a device for monitoring and adjusting tire pressure on trucks to improve fuel efficiency. The device reduces fuel consumption by about 2.5 percent. CLE Resources made its investment through the EnviroTech fund, which was established by the Edison Electric Institute. CLE Resources reported emission reductions of 101,440 metric tons carbon dioxide equivalent for its 6-percent share of the project, based on projected sales of the device. With truck travel accounting for emissions of about 250 million metric tons of carbon dioxide annually in the United States, universal use of the tire pressure device could reduce national emissions by more than 6 million metric tons annually.²⁶

²⁶U.S. Department of Transportation, U.S. Bureau of Transportation Statistics, *National Transportation Statistics 1997*, DOT/VNTSC-BTS-96-4 (Washington, DC, December 1996), Table 4-8, p. 168, <http://www.bts.gov/btsprod/nts/>. Single-unit (2-axle, 6-tire or more) and combination trucks consumed 28,440 gallons of fuel per vehicle in 1995. Assuming an emissions factor of 19 pounds of carbon dioxide per gallon, 249 metric tons of carbon dioxide was emitted per vehicle.